Ecosystem Restoration

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Ecosystem restoration is the activity of improving the condition of our modified natural landscapes and biotic communities in order to provide for the sustainability and for the use and enjoyment of those ecosystems for current and future generations. Ecosystem protection and restoration should be viewed as the proper maintenance in a sustainable manner of California's natural infrastructure, with recognition of the importance of that infrastructure to the future of this state.

Healthy watersheds benefit not only California's plant and wildlife populations, they provide valuable goods and services that support our society and economy as well. According to the Sierra Nevada Ecosystem Project (SNEP) Report: "California's economy derives enormous benefits from water diverted from the streams, rivers and lakes of the Sierra Nevada. A major cost associated with these benefits has been deterioration of the biotic integrity and sustainability of the aquatic systems as reflected in declines in the distribution and abundance of native aquatic and riparian organisms."

Ecosystem restoration is particularly important when threatened and endangered species are involved. Endangered species signal that the health of the ecosystem may be in jeopardy. California today has 293 listed species of rare, threatened, or endangered plants and animals. Restoration of ecosystems often requires taking steps to reduce adverse impacts of water management measures on native species and natural habitat. What steps are needed varies widely depending on a number of factors. For some species, such as native Delta species, recovery plans prescribe actions that can be as simple as screening or moving an irrigation diversion, or as complicated as setting up a regional pollution control program. Additionally, managing the ecosystem and its watersheds in a manner that provides for multi-species benefits is usually a more cost effective and environmentally sound management practice.

Supplying water for human needs is often viewed as competing with supplying water for ecosystem needs. While there are limits to the amount of water that can be withdrawn from a river ecosystem before its health and productivity are compromised, experience with integrating ecosystem restoration and water supply management is demonstrating their compatibility in many cases. Further, the public is recognizing the essential functions performed by California's natural water delivery system - its watersheds - in collecting, storing and improving water quality, when the watersheds are properly managed.

A healthy environment and a sound economy can go hand in hand. In the future, if we are to continue enjoying the aesthetic, recreational, and economic qualities found in California, we

must find ways to assure that our ecosystems are managed in a manner to be able to sustain or improve their condition while allowing for rational growth and productive economic activity. As stated in the SNEP report, "Ecosystem management can and should be designed where possible to contribute to community well-being. Resource management that includes the objectives of improving human well being does not require a trade off with ecosystem health and sustainability objectives. In fact, building this linkage can result in community self-interest ensuring resource stewardship and sustainable resource management, including protection of biodiversity."

The State serves in an important role in ecosystem protection and restoration as the holder of California's Public Trust. The Mono Lake court decision mandates that the State has "an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible."

The Current Condition of California's Ecosystems

In *California Rivers, A Public Trust Report*, (1993) the report "clearly demonstrates the health of California's rivers to be stressed and their viability as sustainable ecosystems in peril. It should no longer be disputed that there exists an urgent need for state agencies to undertake a comprehensive program of river basin and watershed protection and restoration." This report focused on California's rivers; the same conclusions can likely be made for many of California's other aquatic ecosystems and watersheds, including bays, estuaries, and lakes. The current condition of California's fisheries – second only to Hawaii in the number of endangered fish species -along with the status of other native freshwater communities reveal the unintended consequences of our past water management actions.

Water is a critical component of the resource conflicts of the state. Important environmental disputes involve water, as either a primary or a secondary concern. The SNEP Report found that, "Ironically, the primary benefits to society of water from the Sierra Nevada causes the primary impacts. By trying to serve the so-called highest beneficial uses, domestic water supply and production of food and power, we have caused the greatest impacts."

Over the last decade, there has also been a clear recognition of the need to restore California's ecosystems. The current trend toward restoring our ecosystems is largely the result our increased scientific understanding of ecosystem functions and benefits, and of the public's awareness of the value of healthy rivers and the desire to improve them. Successful bond issues (Propositions 204, 13 and 50) have shown a willingness by Californians to obligate billions of dollars to correct some of the damage that has been the legacy of our development and infrastructure projects. The establishment of a planned $1 billion budget for the CALFED Ecosystem Restoration Program through the first seven years of the program is another clear indicator of the emphasis being placed by state and federal agencies in this area. As of the end of 2002, CALFED has funded 379 ecosystem restoration projects at a total cost of $398 million. These investments are augmented by efforts funded through the Central Valley Project Improvement Act. Californians recognize the past damage and future threats and they are willing to pay to restore our ecosystems to a healthy sustainable condition.

The number of local and regional restoration projects and activities throughout the state has significantly increased in recent years. Hundreds of watershed alliances and regional ecosystem projects are in place throughout the state. The success of many of these regional efforts can point the way for the future and help resolve some of the water management disputes that have lingered as part of the state's water history.

Potential Benefits from Ecosystem Restoration

The ecosystem and the watersheds that support it should be considered as California's natural infrastructure. That natural infrastructure supports a growing diverse population and economy, which at times degrades the condition of the natural infrastructure. Ecosystem restoration is an investment in improving the present condition and creating a trend of improved condition for California's natural infrastructure in a way that will support not only the attributes of the ecosystem but also the people and economy of the state in a sustainable manner. The role of ecosystem restoration and its benefits are widespread and are reflected in the peoples general support for properly managing our natural infrastructure and supporting that management with public funds as previously referenced.

The actual benefits from ecosystem restoration can be many including but not limited to; improved flora and fauna condition, the recovery of endangered species, improved watershed condition and trend, improved water quality, improved natural groundwater recharge capability and widespread public resource use benefits.

California's recreation and tourism industry – at $75 billion a year – is one of the state's largest industries. Next to the state's beaches, rivers are the second biggest attraction for California's recreation industry. Similarly, managed wetlands and wildlife refuges provide bird watching and hunting opportunities that contribute hundreds of millions of dollars annually to California's economy. The current trend toward restoring our ecosystems is largely the result of the public's awareness of the value of healthy rivers and ecosystems and the desire to improve the conditions of those ecosystems. Recognition also continually grows about the nexus between water supply reliability, water quality and ecological restoration, between water management and the health of the natural infrastructure. As our understanding of the linkage between water management and the health of the natural infrastructure grows, the benefits of restoration to water supply reliability and water quality improvements are increasingly evident. . As ecosystem restoration actions help increase the health and abundance of species currently protected under the state and federal Endangered Species Acts, there will be fewer ESA conflicts throughout the state. The result will be a more reliable, higher quality water supply supported by a sustainable ecosystem. The sample local and regional restoration projects described below are also indications of the benefits as well as costs to local jurisdictions for the many projects that are being undertaken throughout the state.

Costs of Ecosystem Restoration

Data does not currently exist on a statewide basis that collects or summarizes ecosystem restoration projects and their costs. However, it can be said that the costs of restoration are, in most if not all cases, higher than the costs of protecting existing healthy ecosystems.

The absence of data on a statewide basis of local and regional projects hinders the formulation of statewide coordination and policies regarding recovery activities. The collection of data related to ongoing and future projects could provide a forum for coordination and for the distribution and assimilation of knowledge about recovery activities. That information coupled with adequate, regular reporting of the outcome of various restoration and management strategies could be a guide to more efficient investment of public funds. Further, as more information is accumulated, the proper role of other funding sources could be evaluated for inclusion in the portfolio.

The effect that improved rivers, estuaries, wetlands, wildlife, beaches, and their surrounding habitats can have in the state may far exceed the investments that are being made for restoring ecosystems. When looked at from an economic point of view and considering California lifestyle trends and travel and tourism as the major growth industry for the state, investments in ecosystem restoration actions may provide the highest return on investment among the alternatives. This is in stark contrast with mere land development investments for urban growth, for example, which result in a negative return on investment to the public as the infrastructure needs to service these added population levels taxes local and regional government services such as road development, fire and police protection.

Major Issues Facing California's Ecosystems

The major causes of aquatic and riparian habitat degradation and freshwater biodiversity declines throughout the state are directly linked to hydrologic alteration from early hydraulic gold mining activity, the development of large foothill dams and diversions, the development of numerous hydroelectric generation facilities, water quality degradation from certain forestry land use practices, transportation development, and urban and agriculture development, as well as the decline of native species and predation and competition from invasive species. Over the last 100 years, the scope of these threats has increased exponentially, paralleling the six-fold increase in our appetite for the range of services provided by freshwater ecosystems (transportation, irrigation, recreation, municipal and industrial supplies and energy production). Although efforts at conservation and recycling are growing, our continued reliance on historic water management methods, coupled with other contributing resource management strategies may lead to future water supply shortages, lower water quality and loss of groundwater recharge capability, as well as lasting ecosystem degradation. Each of these main causes and related issues are discussed below.

Dams and Diversions

The construction of a large number of dams in California – 1,400 major dams and numerous small ones throughout the state – has occurred in large part because of the number of services they provide: relatively inexpensive and efficient power generation,

flood control, municipal and industrial water supply, irrigation, and recreational opportunities. But the presence of dams is problematic for aquatic systems, watersheds and riverine habitats. Dams impact ecosystems in a number of ways: altering the natural cycle of flow, increasing water temperatures, altering the amount of water in a river or stream, transforming the biological and physical characteristics of river channels and floodplains, altering the composition and extent of riparian habitat along stream banks, and fragmenting the continuity of rivers. Sediment transport is blocked by dams and limited by fewer over bank floods in a dammed river. Coastal areas may lose valuable habitat and shift biotic composition when they are deprived of sediment because of dammed rivers upstream. The physical obstruction of dams and reservoirs impedes the migration of fish. An estimated 95 percent of the historical spawning and rearing habitat for Steelhead populations in the Central Valley is inaccessible due to blocked access from impassable dams.

Alteration of flows by means of dams or diversions can be the single most important factor influencing the health of many riverine and estuarine ecosystems and can eliminate populations of species dependent upon rivers for reproduction. The turbines of unscreened or improperly screened hydropower operations and pumps harm fish and other biota as they attempt to pass. The change from a free flowing river to a reservoir ecosystem often significantly changes species composition. This cascades into invasive species introductions that further alter natural biotic communities sometimes in irreversible ways. Unnatural timing of flow releases for power production and water supplies and the effects on water quality and quantity can confound fishery emergence or growth cues. In other cases cold water releases in streams and rivers from reservoirs during summer months have enhanced some species populations, but displaced others.

Water diversions can be as simple as siphons from a river bed for irrigation and as complex as the state and federal projects and their massive pumps at the Bay-Delta which can move millions of acre feet of water each year for farming and growing populations in the central and southern parts of the state. A complex system of water rights precedents and western water laws has contributed to the over allocation of water from most of the state's major river systems. The unmet needs of water to be used for restoration has been a growing area of controversy throughout the state. Diversions degrade the ecosystem in a number of ways depending on the type, size, and screening technology employed. Impacts range from removal of water and alteration of flows, to entrainment and increased predation of fish. Given their wide use, impacts from diversions are witnessed throughout the state. One of the most problematic areas is the Bay-Delta watershed, which contains thousands of diversions, thousands of miles of canals, and 660 major dams designed to divert, store, and deliver water. These water projects divert up to 60 percent of the natural runoff in the watershed in some years, and in the case of the San Joaquin River, over 95% of the natural flow. During times of intensive water pumping, state and federal water projects remove so much water that they reverse the natural stream flows in South Delta channels, draw salt water upstream into freshwater fisheries, confusing fish that are migrating upstream, and interfering with the downstream drift of eggs and young. Thousands of unscreened intakes in the Delta, the primary nursery area located above San Francisco Bay, also kill millions of young salmon, steelhead, smelt and striped bass annually.

Degradation of Water Quality

Throughout California water quality impairments threaten ecosystem health and, in some cases, are major impediments to restoration. Urban activities, industry, mining, agriculture, and even recreation – given sufficient intensity – play a part in water quality degradation. Poor water quality can result from a combination of factors, such as introduced pollutants, intensive reuse of water, and depletion of fresh flows. Furthermore, history instructs us to be cautious about substances we introduce – whether directly or indirectly – into our rivers, lakes, bays, and other waters. Many significant pollution problems today are the result of persistent "legacy" pollutants such as mercury (extracted from the Valley coastal range and used to process gold in the Sierra mines in the last century) and PCBs. The 1992 Water Quality Assessment listed twenty-one streams draining the west slope of the Sierra Nevada as having serious problems. The principal problems in more than half these cases were degradation of fisheries habitat and inadequate flow.

Although there may be a perception that, with water treatment, urban areas are managing their water quality well, the fact is urban use contributes significant amounts of pollutants, such as pesticides applied to turf and gardens. Moreover, the industrial and energy-production processes supporting our population can give rise to water pollution problems, one example being atmospheric deposition of mercury, which in the methylated form is taken up in the ecosystem.

In rural areas the main pollution sources can come directly from land use practices both present and past. As an example, the Sierra Nevada Ecosystem Project notes that, "After hydraulic mining was halted, some of the debris created earlier continued to move through the rivers, largely in pulses during peak flows. Debris that was not entrained during the phase of active stream incision continues to erode into channels and perpetuates the enhanced sediment delivery of the affected streams. Many of the small debris dams intended to stabilize mining sediment failed and released the stored material. Large dams have effectively stopped the transport of upstream sediment to the lower reaches of main rivers. Even after a century, exposed surfaces in the pits continue to erode through the mass failures, gullying, rain splash, and rill erosion and produces substantially elevated sediment concentrations downstream of the old mine sites. The total volume of mining debris delivered to the Central Valley has been estimated at about 1.1 billion cubic meters (900,000 acre feet) from five rivers." In addition, logging and related road cuts are a major cause of high sediment loads to north coast streams where efforts are being made to protect anadromous fish runs. Transportation corridors for vehicular access result in significant erosion into watersheds throughout the costal and inland areas. By introducing measures to cut erosion and landslides, by protecting streamside vegetation, and properly managing watersheds, we can protect instream habitat and water temperature. Grazing impacts, such as increased erosion, loss of streamside vegetation, mountain meadow loss of groundwater recharge ability, and nutrient inputs, can also be managed through watershed planning and management as well as pollution control measures tailored to specific locations.

The San Joaquin Valley exemplifies the challenges of a predominantly agricultural water use system, reliant on very intensive application of available surface and groundwater supplies, with depleted fresh flows due to upstream dams and diversions and inter basin transfers. The numerous water quality problems include high levels of pesticides, organic matter and nutrients, and selenium. In combination with low flows, these pollutants can be toxic to fish, wildlife, and

aquatic invertebrates. Lowering the pollution levels will require a variety of changes at the farm, district, and regional levels—for example, reducing and controlling pesticide application; containing dairy waste; collecting and removing concentrated selenium from the biosystem; and retiring and managing selenium-source lands.

Although water quality is often discussed – and regulated – on a pollutant-by-pollutant basis, our watersheds, rivers, lakes, and bays are exposed to a mix of pollutants; much has yet to be understood about the combined effects of chemicals, temperature, pH, transport, sunlight, and other factors. Some pollutants bind to sediments, which can be one reason for controlling sediment inputs to waters. Some are persistent and/or bioaccumulative – that is, their concentration magnifies in the food chain (for example, mercury and selenium). From the standpoint of ecosystem integrity, it is important to recognize that major threats may not be observed fish kills, but instead may occur through subtle "sub-lethal" changes in gene structure, nervous system functions, or immune response. Such changes over time can affect species survival, and population and ecosystem structure. Similarly, toxicity to key elements of the food chain, such as aquatic invertebrates, is cause for alarm because of potential impacts to the larger ecosystem.

Endangered Species

Chinook salmon and steelhead are highly valued biological resources and a significant biological legacy of California. Central Valley Chinook salmon comprise numerous individual stocks, including the Sacramento fall-run, late-fall run, spring-run, winter-run and San Joaquin fall-run. Central Valley steelhead is an anadromous form of rainbow trout. The continued existence of Central Valley Chinook salmon and steelhead is closely linked to overall ecosystem integrity and health. Salmonid populations declined significantly by the 1990s resulting in the need for immediate protection under the California Endangered Species Act (CESA) and federal Endangered Species Act (ESA).

The National Marine Fisheries Service has identified major groupings of salmonids, called evolutionarily significant units or ESUs, based on ecological, geographical, and genetic differences among stocks. The Sacramento River winter-run Chinook salmon ESU is listed as endangered under CESA and ESA. The Central Valley spring-run Chinook salmon ESU is listed as threatened under CESA and federal ESA. The Central Valley fall/late fall-run ESU is presently a candidate for listing under the federal ESA. The Central Valley steelhead is a threatened species under the federal ESA.

One of the more stark examples of a historically declining salmon population is the Sacramento River winter-run Chinook salmon ESU. From about the mid-1960s through the mid-1970s annual estimates of winter-run salmon migrating past Red Bluff Diversion Dam (RBDD) numbered in the tens of thousands. Estimates for the years 1968 and 1969 were 84,414 and 117,808 adults, respectively. During the late 1980s and early 1990s a precipitous decline in winter-run salmon occurred with counts at RBDD numbering in only the hundreds in most years, which lead to the listing of winter-run Chinook under the ESA. Since the mid-1990s there has been a slight increase in adult returns in response to a variety of measures to reduce mortality. The 2001 and 2002 cohorts numbered in the 7,000-9,000 ranges.

In 1995 the California and federal governments joined to form CALFED, a consortium of state and federal agencies with principal authority over fish and wildlife and water resources in the California's San Francisco Bay-Sacramento and San Joaquin Delta and its watershed. The CALFED agencies, working with stakeholders, have crafted the CALFED Bay-Delta Program, a 30-year plan to improve the quality and reliability of the state's water supplies and to restore the ecological health of the Bay-Delta and its watershed. The CALFED program seeks to achieve recovery of at-risk native species dependent on the Delta (including the salmonid ESUs described above), and support recovery of at-risk native species in the San Francisco Bay and watershed through implementation of the CALFED Ecosystem Restoration Program, Watershed Program, Multi-species Conservation Strategy, and Environmental Water Account. The expectation is that as these at-risk fish populations will be recovered and large, self-sustaining populations will be established, greater water supply reliability to water users in the CVP/SWP export service area will be achieved, and the need for future listings under the endangered species acts will be averted.

Additionally, the comprehensive Ecosystem Restoration Program Plan described in the CALFED Record of Decision and the planned restoration actions of the Department of Fish and Game – the state agency charged with the main responsibilities for ecosystem restoration activities – are hampered by federal and state budget shortfalls and are well behind in achieving the planned levels of habitat and species recovery.

Invasive Species

Aquatic non-native species invasions in various locations of the United States and world have harmed public health, decimated fisheries, and impeded or blocked water deliveries. The San Francisco Bay-Delta estuary is known to be the most invaded estuary in the world with a new species added about every 14 weeks. New non-native invasive species can greatly increase the expense and difficulty of restoring the estuary and may present a significant obstacle to our ability to recover at-risk species. The CALFED Ecosystem Restoration Program has a strategic goal to prevent the establishment of additional non-native invasive species and reduce the negative ecological and economic impacts of established non-native species in the Bay-Delta estuary and its watershed.

Non-indigenous invasive animals and plants threaten native species through predation, competition for limited resources, and habitat degradation. Often such invasive species gain a foothold through intentional introductions to limited areas by wildlife management agencies and private citizens. Other times, introductions are unintentional, such as the use of tamarisk, arundo and Russian olive in landscaping and sale at local lawn and garden stores across the western United States. Hydrologic modification also often creates conditions favoring non-native invasive species, to the detriment of native species. The end result, however, often is the same: invasive species will compete with native species in degraded habitat conditions allowing them to replace native stocks in rivers, lakes, and wetlands. With at least 100 non-native species now recorded from southern California alone, the area has the dubious honor of exceeding all other areas in the state in the number of exotics established.

Sample Restoration Projects

The recognition that our ecosystems need to be restored to reasonably intact and functioning levels has led to a plethora of habitat restoration projects in almost every county of the state. A sampling of the variety of ecosystems restoration projects – including riverine, wetland, and estuary projects – that are occurring throughout the state are described below. These projects show both the benefits to be accrued from these projects as well as the magnitude of costs for their accomplishment. In many cases, the costs can be considered the externalized – or the full costs – of past developmental projects.

City of Arcata Wastewater Treatment Facility and Marsh and Wildlife Sanctuary
The Arcata Integrated Wastewater Treatment Facility and Marsh and Wildlife Sanctuary are located in the City of Arcata at the north end of Humboldt Bay in northern California. Arcata's Wastewater Treatment Facility uses a unique approach to wastewater treatment that includes wetland wastewater treatment, wetland enhancement and salmon ranching. The project uses a marsh system to provide secondary treatment for the City's wastewater, wildlife habitat and passive public recreation. The marshes are part of the 154-acre Arcata Marsh and Wildlife Sanctuary that includes two additional wetland restoration projects. There is also a small fish-rearing operation at the treatment plant that utilizes treated sewage. The aquaculture facility is operated by Humboldt State University under a cooperative agreement with the City.

In 1978 the citizens of Arcata had organized to call for a local integrated wastewater treatment plant that would utilize the natural treatment process of marshes. Soon after that the City obtained State approval to demonstrate "enhancement" with a two-year pilot project designed to treat 10% of Arcata's wastewater. During this same time the City worked with the California Coastal Conservancy to complete the original 75-acre Arcata Marsh and Wildlife Sanctuary. The Sanctuary was completed in 1981. At that time the marshes were fed with well water. In 1983 the State Water Resources Control Board gave the City permission to upgrade its wastewater treatment plant, using wetland treatment/enhancement units. Discharge to Humboldt Bay was approved since the State determined that the project provided enhancement for wildlife and opportunities for research and education. The integrated wastewater treatment plant was completed in 1986 at a cost of $7.1 million. The project was financed using 75% federal, 12.5% state and 12.5% local funds. The project was completed in 1986 and is an on-going operation.

The Cosumnes River Preserve
The Cosumnes River Preserve in southern Sacramento County is a mosaic of many habitats. Some of these include cottonwood-willow woodland, oak savanna, fresh water tidal wetlands and swamps, seasonal wetlands, managed wetlands, agricultural fields, grasslands, vernal pools, numerous sloughs off the main channel of the river, seasonal creeks, a small perennial lake, and the best remaining valley oak riparian woodland in California. The preserve is a partnership of several co-owners, including the Nature Conservancy, Bureau of Land Management, Ducks Unlimited, County of Sacramento, and California Departments of Fish and Game and Water Resources. Additionally, several farms and ranches have sold conservation easements on their adjacent properties. The importance of the Cosumnes is that it is the last undammed river draining a portion of the west slope of the Sierra Nevada, so habitats here still respond to natural cycles of flood and drought. With recent additions in the lower foothills and in the Sacramento-San Joaquin River Delta, the preserve now has about 35,000 acres under management. The Cosumnes floodplain is a haven for tens of thousands of migratory waterfowl, songbirds, and

raptors, for a large portion of the Central Valley's population of greater sand hill cranes, and for rare reptiles and mammals like the endangered giant garter snake and the elusive river otter. Chinook salmon, steelhead and Pacific lamprey still swim upstream to spawn, and native Delta fish breed and rear in the shallow waters of the wetlands.

By joining with other organizations, public agencies, and private landowners as partners in the preserve, The Nature Conservancy has been able to protect a much larger and more ecologically viable area. Expanding the core preserve and working to ensure that key buffer lands surrounding it are devoted to wildlife-friendly, sustainable agricultural practices remain matters of considerable urgency. One of the objectives to the preserve is to ensure that restoration projects are large enough in scale to make a real difference for plants and animals and that these projects can exist in harmony with productive, privately-owned businesses that do not harm the environment. The Cosumnes River Project demonstrates the feasibility of "win-win" solutions to the environmental stresses of the San Joaquin Delta. Efforts on the Cosumnes can be a major step towards reestablishing viable populations of sensitive species throughout their historic ranges. There are also other demonstrated practical benefits, which include flood control, water quality improvements, economic vitality, recreational usage, and open spaces.

Tuolumne River Restoration

Urban, agricultural, and environmental stakeholders have developed a comprehensive restoration plan to guide the implementation of FERC-mandated projects for rehabilitating the salmon run on the lower Tuolumne River. The plan, called the *Habitat Restoration Plan for the Lower Tuolumne River,* addresses the need for higher base flows year-round and a flow schedule more appropriate for the life-cycle of salmon, an extensive monitoring program of Tuolumne salmon and river conditions with Turlock Irrigation District (TID), Modesto Irrigation District (MID), and City and County of San Francisco (CCSF) committing $1,355,000 towards monitoring costs, a $500,000 commitment from CCSF toward riparian restoration projects on the river, and a commitment by the TID, MID, and CCSF to complete the 10 salmon restoration projects on the lower river while contributing $1,000,000 toward this objective.

This final mandate has resulted in over $40,000,000 in leveraged funds from the Anadromous Fish Restoration Program and CALFED Bay-Delta Program committed toward restoration projects on the lower river. To date, two of the 10 projects have been fully implemented, and the other eight are either partially or fully funded. The projects primarily consist of predator reduction, channel reconstruction and floodway enlargement, and sediment management.

Dutch Slough

The Dutch Slough project is a collaborative project to restore approximately 1200 acres of diked lands to freshwater tidal marsh in the City of Oakley in northeast Contra Costa County. Unlike all other large tidal marsh restoration project in the Delta, the project is located in the western Delta where all the Delta's endangered fish congregate or migrate through, and thus it will provide major benefits for endangered species recovery. The site is ideally configured for implementation as a large-scale adaptive management restoration experiment that will yield important information about the Delta's endangered species and habitats as well as the most efficacious methods for restoring them. The project is designed to provide access to the Delta shoreline and serve the local community.

The project enjoys strong support from local residents, politicians, and organizations but has not yet gained the support of the Oakley City Council. The Natural Heritage Institute initiated the project with the present property owners, developed the present partnership, led the effort to obtain funding, and is now assisting with project planning and the development of a long-term adaptive management plan. The Coastal Conservancy is administering the project; the Conservation Fund is managing the land acquisition phase; the Department of Water Resources will implement the physical restoration and assume long-term ownership of the property; and the City of Oakley will develop a community park at the entrance of the site.

Matilija Creek Restoration and Dam Removal

The Ventura River basin and its major tributary, Matilija Creek, are situated along the southern California coastline less than 60 miles north of the Los Angeles metropolitan area. Matilija Dam was constructed in 1948 near the confluence of the two rivers in order to provide flood control and water supply benefits. From the outset, Matilija Dam was plagued with safety considerations due to weakening of the concrete and was completely silt filled by the 1970's. Pressure began to mount in the early 1990's to remove the dam and restore the Matilija watershed in order to provide a recreational river area, to permit the passage of steelhead trout into the upper reaches of Matilija Creek, and to provide the natural replenishment of sand to Ventura County beaches that was precluded with the construction of the dam.

A Bureau of Reclamation Appraisal Study was completed in 2000 and the Matilija Dam Ecosystem Restoration Feasibility Study began in the summer of 2001. The Army Corps of Engineers is the lead agency in a collaborative effort that includes many federal, state, and local government agencies and has large local support. The goal of the feasibility study is to determine the preferred method for removing the dam to restore the Ventura River ecosystem, while considering all the environmental risks and benefits. Since a dam of this type and size (160 feet average height) has never before been decommissioned, the study is complex and will be completed during 2004.

Santa Ana River Trail and Parkway Project

The Santa Ana River watershed – which drains parts of Orange, San Bernardino and Riverside counties – has many facets. In addition to serving as a source of water for the growing Inland Empire, it is also a source of hydroelectric power. Its tendency towards seasonal flooding has resulted in two large dams along the river. Current efforts, under the leadership of the Santa Ana Watershed Project Authority (SAWPA), include conservation efforts directed at water quality and habitat preservation as well as planning appropriate recreational uses that showcase the river and provide a place for people to enjoy this important resource. Growth projections show that, over the next decade, Inland Empire growth will exceed that of all states except California, Texas and Florida. With growth will come the increased responsibility to preserve and protect valuable natural resources and to provide a healthy and enriching environment in which to enjoy recreational activities.

As recognition of this responsibility, one of the activities of SAWPA is the construction of the Santa Ana River Trail and Parkway that will be a large step in the preservation and enrichment

of this recreational heritage. The extensive willow woodland in the Basin is the largest of its kind remaining in Southern California. A well-designed trail will provide an opportunity for visitors to enjoy the natural beauty of this special place. When completed, the 110 mile long Santa Ana River bicycling, riding and hiking trail will extend from the Pacific Ocean to the San Bernardino Mountains, providing recreational and commuting opportunities in all three Counties. Visitors will be able to bicycle or ride from the Bolsa Chica State Ecological Reserve along the coast to the newly forming San Timoteo Canyon State Park, enjoying Huntington Beach State Park, Chino Hills State Park including Coal Canyon, Prado Basin and the Hidden Valley Wildlife Preserve along the way.

The project is collaboration with numerous county, city, federal, state, and local agencies as well as non-profit and private organizations. As of mid 2003, the trail is approximately 40 % complete. Projected remaining costs are in the neighborhood of $20 million, depending on when they are accomplished.

As a result of synthesis and analysis of the above sample projects, a number of conclusions can be drawn:

- There is a lack of state level data on the number, types, and magnitude of restoration activities that are being accomplished on local and regional levels. Compilation of that kind of data can be useful for agencies contemplating restoration activities in the future and for identifying needed restoration actions.

- Most of the restoration activities being accomplished throughout the state are single purpose actions and most are not designed to handle multiple species issues or tackle multiple interrelated issues in a common basin or watershed.

- Despite the ability of some state agencies to provide funding for local and regional agencies who apply for restoration funding, there is no "guiding hand" at the state level for determining important restoration needs at local and regional levels and prompting beneficial restoration actions to improve public trust resources. This is an activity that is appropriate within the Resources Agency.

The effect that improved rivers, estuaries, wetlands, wildlife, beaches, and their surrounding habitats can have in the state may far exceed the investments that are being made for restoring ecosystems. When looked at from an economic point of view and considering California lifestyle trends and travel and tourism as the major growth industry for the state, investments in ecosystem restoration actions may provide the highest return on investment among the alternatives. This is in stark contrast with mere land development investments for urban growth, for example, which result in a negative return on investment to the public as the infrastructure needs to service these added population levels taxes local and regional government services such as road development, fire and police protection.

The above projects show the varying objectives and benefits that can accrue through ecosystem recovery actions. As can be observed about these projects and similar ones throughout the state, each project addresses one or more of the major issues discussed in the previous section. They

represent a commitment on the part of the citizens of California toward improving our natural habitats and the quality of our water and in providing recreation for the growing population of the state.

Major Recommendations for Ecosystems

1. A statewide information database on restoration projects must be established, maintained and be made readily available by the Resources Agency in order to provide information to local agencies and to identify restoration actions that need to be accomplished. This database should lead to the identification of needed restorations throughout the state (in addition to the already identified CALFED actions) and provide a coordinated and comprehensive statewide implementation plan for restoration actions in each region.
2. The Resource Agency must investigate the imposition of legislatively directed user fees for state provided water in order to provide additional budget for Fish and Game to accomplish a more comprehensive series of restoration actions throughout the state. The Agency should take the lead in coordinating and advocating for a similar set of additional user fees for Federal and local projects in order to provide budgets that can be expected to recover degraded habitats and at risk species.
3. The Department of Water Resources (DWR), the State Water Resources Control Board (SWRCB), the Department of Fish and Game (DFG) and California EPA should publish comprehensive assessments of the condition of public trust assets under their protection and disclose project-specific and cumulative effects of proposed transfers, storage projects, conveyance improvements, conjunctive management initiatives on public trust resources prior to approval or implementation.
4. The Department of Water Resources must develop a closer relationship with the Department of Health Services that will allow joint funding of projects that benefit both drinking water quality and ecosystem restoration. This can include the upgrading septic systems in areas where nitrates threaten drinking water or implementing or improving treatment of storm water runoff where it can impact drinking water quality.
5. SWRCB and DWR should work together to integrate management operations for water supply, water quality and flood management where each agency has responsibilities for operations. These agencies should solicit the US Army Corps of Engineers and the US Bureau of Reclamation to integrate their water supply and flood management operations within California.
6. The State should explicitly define “reasonable beneficial use” to include fish and wildlife benefits, as per the tenets of the public trust doctrine.

Information Sources

Bednarek, Angela T. 2001. Undamming Rivers: A Review of the Ecological Impacts of Dam Removal. Environmental Management, Vol 27, Pages 803-814.

CALFED, Bay-Delta Program, *Ecosystem Restoration Program Plan, Strategic Plan for Ecosystem Restoration*, July 2000.

California Department of Fish and Game. 2000. The Status of Rare, Threatened, and Endangered Animals and Plants of California.

California State Lands Commission. 1993. California's Rivers, A Public Trust Report. Sacramento.

City of Arcada Web Site: www.arcadacityhall.org

Environmental Water Caucus, *Blueprint for an Environmentally and Economically Sound CALFED Water Supply Reliability Program,* November 5, 1998.

Sierra Nevada Ecosystem Project Report. United States Forest Service. Final Report to Congress, 1996.

State Water Resources Control Board, 202 CWA 303(d) list of impaired water segments. Impaired waters: defined pursuant to Section 303(d) of the Clean Water Act.

Swift, C.C., T.R. Haglund, M. Ruiz, and R.N. Fisher. 1993. The status and distribution of freshwater fishes of Southern California. Bulletin of the Southern California Academy of Sciences 92: 101-167.)

The Cosumnes River Preserve Web Site: www.cosumnes.org

The Natural Heritage Institute Web Site: www.n-h-i.org

The Nature Conservancy's Freshwater Initiative Web Site: www.freshwater.org